HUS-1000

HEUI SYSTEM TEST BENCH

USER'S MANUAL

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This USER'S MANUAL allows you to exploit all the functions of the HUS-1000 test bench. We strongly suggest you to read this manual with attention before using the equipment, and retain it for future reference.

1 PREFACE

1.1 Symbols

The following symbols are used throughout this manual. Safety warnings must be strictly observed during operation.

Caution: Cautions describe conditions, activities, operations which could result in danger.

Note: Notes provide important supplementary information.

1.2 Application

The HUS-1000 test bench is designed to test up to four HEUI injectors equipped on the following engines:

- Navistar T444E, as Ford 7.3L PowerStroke Engines
- Navistar DT466E
- Navistar I530E
- Caterpillar 3126B
- Add-on kits to test HEUI injectors of Ford 6.0L PowerStroke engines.

1.3 Function

The HUS-1000 test bench is designed to perform the following tests.

- Measure fuel deliveries of up to four injectors

- Check sealing for injector upper seat of the solenoid control valve of individual injector
- Check needle opening pressure and nozzle spray pattern analysis with optional POP test adapting kits

1.4 Specification

Items	Parameters
AC Power Supply	3-Phase, 230V/380V/460V，50/60Hz
Main motor	Inductive, divider control motor speed
Max Power Supply	7.5kW
Max Actuator Pump Speed	1500rpm
Max Supply Pressure	90psi
Max Actuation Pressure	3000psi
Actuation Oil Pressure Gauge	Analogue gauge, 0 – 140psi
Supply Pressure Gauge	Analogue gauge, 0 – 5000psi
Tank Capacity	11 US gallons
Temperature Control module	(30℃~50℃）±1℃ LCD display
Test Oil	The HUS-1000 is designed to be run on single test oil for both the low and high pressure actuation supplies to the injector. The test oil used therefore needs to have proper lubricating properties, and for this purpose Chinahanji recommends Rock Valley C-3112 Type 2 Calibration Fluid.
Test oil filtration	5μm, Full Flow, fuel filter Fleetguard FF5485
Dimension	Width×Depth×Height=1200×700×1700(mm)
Weight	Net：450kg Gross：500kg

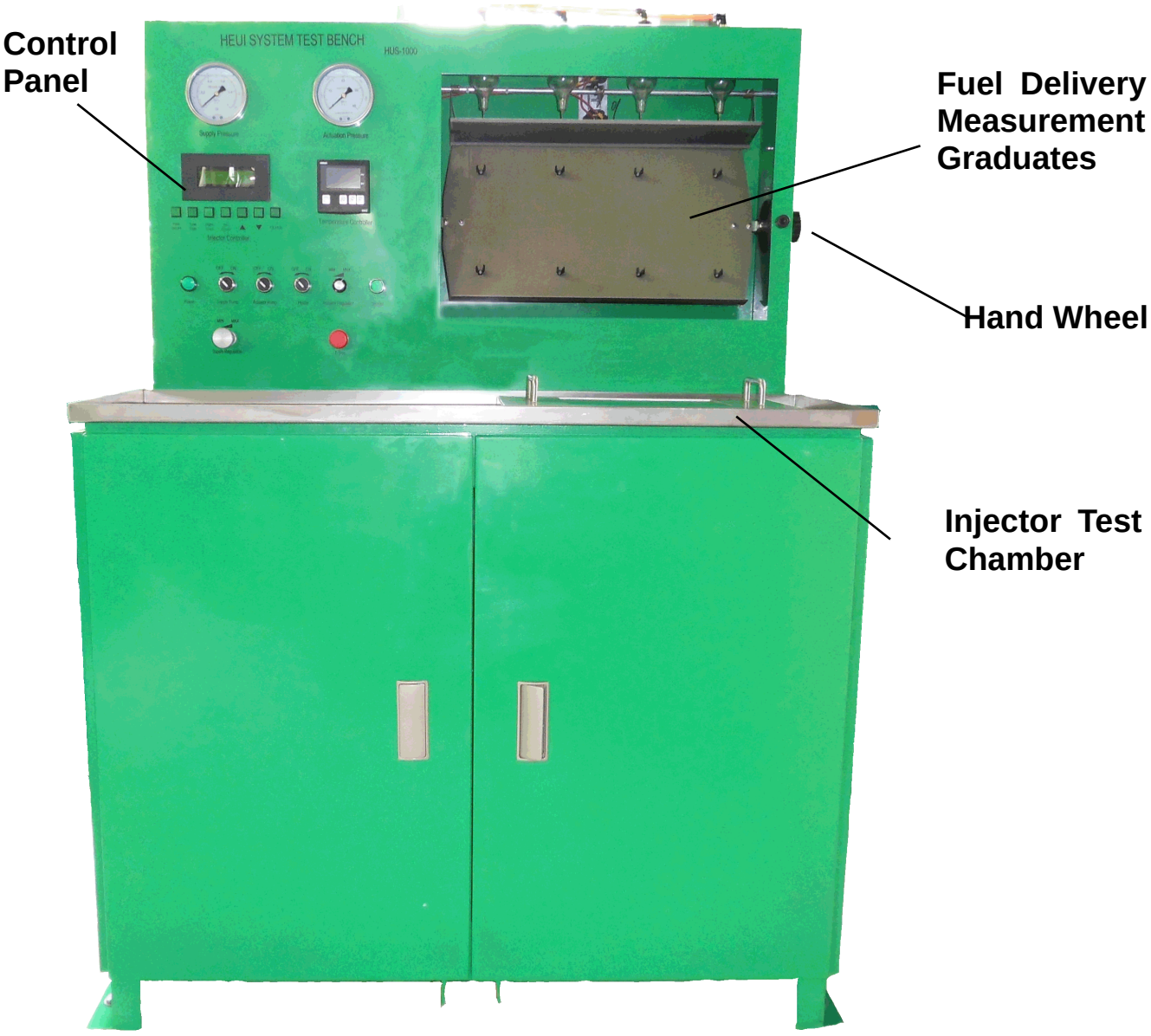
1.5 Main Features of HEUI Control Module

Range of fuel injection frequency	0~2000
Range of Injection Pulse Width	0~6.0ms
Range Fuel Delivery Measurement Counter	1~9999
Simple, User-Friendly Display and Mini-Key Pad	

2 HUS-1000 Test Bench Description

2.1 Test Bench Panel Description

Front view of the HUS-1000 test bench



2.1.1 Front Panel

There are display meters, switches/buttons, a hand wheels to regulate pressures, oil temperature control module, and HEUI control module on the front panel of the HUS-1000 test bench. The photo below is the front panel of the test bench.

The followings list the devices and their functions on the front panel.

- <Supply Pressure>

  Analog pressure gauge to display the supply pressure

- <Actuation Pressure>

Analog pressure gauge to display the test oil actuation pressure

- <Injector Controller>

HEUI injector control module

- <Temperature Controller>

Test Oil Temperature displayed and Test oil temperature control module

- <Test Bench Controller>

♦ <Power>

Indication light of AC Power

♦ <Supply Pump>

Switch for supply pump ON /OFF

♦ <Actuator Pump>

Switch for test oil actuation pump ON /OFF

♦ <Heater>

Switch for test oil heater ON/OFF

♦ <Actuator Regulation>

Knob of potentiometer to adjust actuation pressure

♦ <Counter>

Push button to start fuel injection quantity measurement. Stop the measurement during the fuel delivery test by pushing the button again.

♦ <Supply Regulation>

Hand wheel to adjust fuel supply pressure. Turn it clockwise to increase fuel supply pressure.

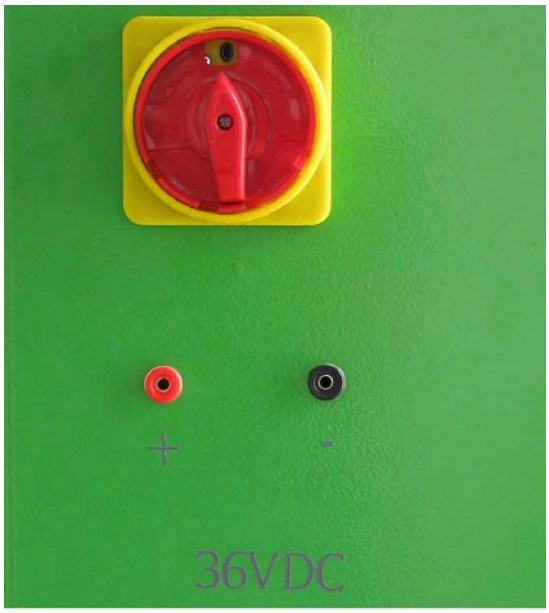
♦ <E-Stop>

Button for emergency stop

2.1.2 Left Side Panel

The red turning switch on the left panel is the main power switch. The AC power of the HUS-1000 is ON when the switch is turned to position "**ON**". The power indicator on the front panel will be lightened once the AC main power is ON.

The photo below is the left side panel of the test bench



The 36VDC power output banana terminal sockets below the main AC power switch provide DC power for the leakage testing device.

Cooling water inlet and outlet ports are mounted on the lower left side panel.

2.2 Hydraulic Circuit

Figure 1 shows the hydraulic circuit of the HUS-1000 Test bench.

2.2.1 Injector test chamber

A special designed test head block is installed in the chamber. The test head block has four HEUI injector mounting cavities for injector installation. Similar to an engine cylinder head, the test head block has two galleries to connect the four injector cavities. The upper gallery provides actuation test oil and the lower one provides low pressure fuel supply for each injector. There is a bleeding valve at the end of the actuation oil gallery for purging the trapped air in the gallery.

A hose to test oil tank is connected to the bottom of the test head chamber for test oil returning flow. Because of this flow passage, the user can pure test oil into the test chamber to fill test oil.

2.2.2 Actuation pressure control

The actuation pump output pressure is controlled by varying the pump speed. A potentiometer knob on the control panel is used to adjust the actuation pressure, which is monitored by an analog pressure gauge on the front panel.

A pressure relieve valve inside of the bench at the up-left corner of the electrical chamber is used to limit the maximum actuation pressure. Adjustment of the maximum actuation pressure can be done by a hand wheel of the pressure relieve valve, clockwise to increase and count-clockwise to decrease the maximum actuation pressure.

2.2.3 Supply pressure control

A pressure regulation valve with a hand wheel on the front panel is used to adjust oil supply pressure. To turn the hand wheel clockwise or counter-clockwise will increase or decrease supply pressure. The supply pressure is monitored by an analog pressure gauge on the front panel.

2.2.4 Test oil temperature control

The HUS-1000 test bench equipped with an automatic oil temperature control system, which consists of a temperature controller, an oil-to-water heat exchanger, cooling water flow solenoid regulator and an electrical heater. The target test oil temperature is set by the user. The electrical heater is ON when the test oil temperature is lower than the target temperature and the cooling water flow solenoid regulator is ON when the test oil temperature is higher than the target temperature. The test oil temperature can be controlled within 1℃ at the target temperature.

2.2.5 Test oil tank

The volume of the test oil tank is 11 US gallons. The oil level in the tank can be observed via the transparent tube at the back of the bench. The electrical heater is installed in the tank.

2.2.6 Test Oil Filtration

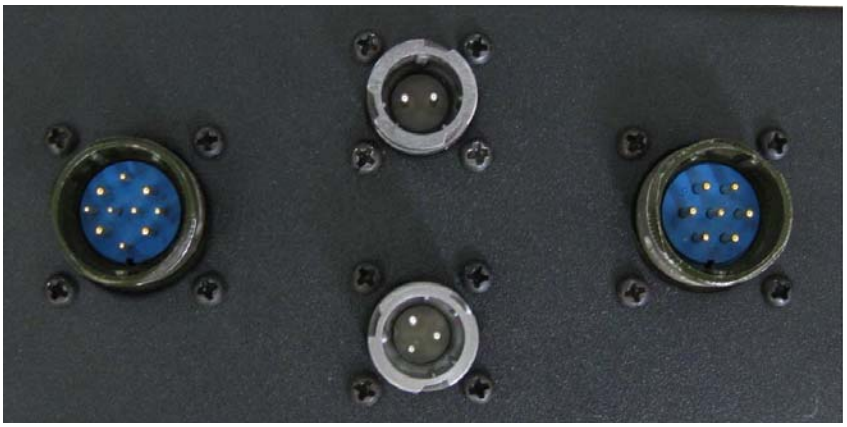
Two test oil filters are applied.

2.3 HEUI Control Module

The HEUI control module box is installed on the front panel of the test bench. A LCD screen and on the control module displays injector setting and operational parameters. A mini-keypad on the front panel is used to edit the parameters.

The photo below is the front panel of the module

The photo below is the back panel of the module



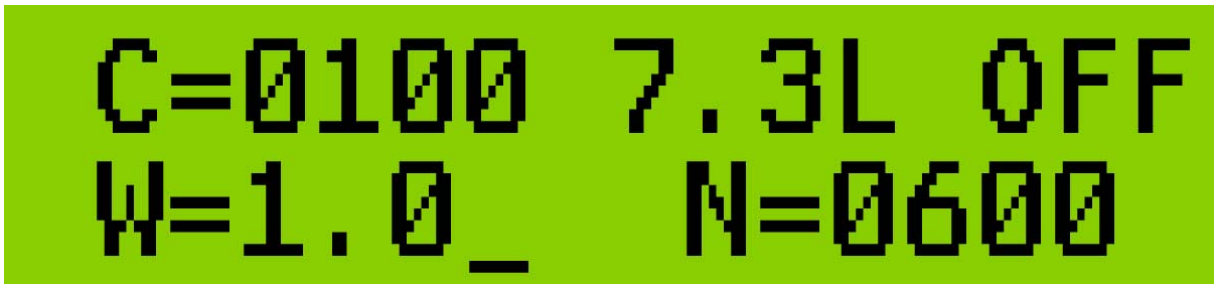
The sockets on the back panel are：

- HEUI injector
- Mini keypad
- Solenoid to control the plate to direct fuel flow
- 36VDC Power supply

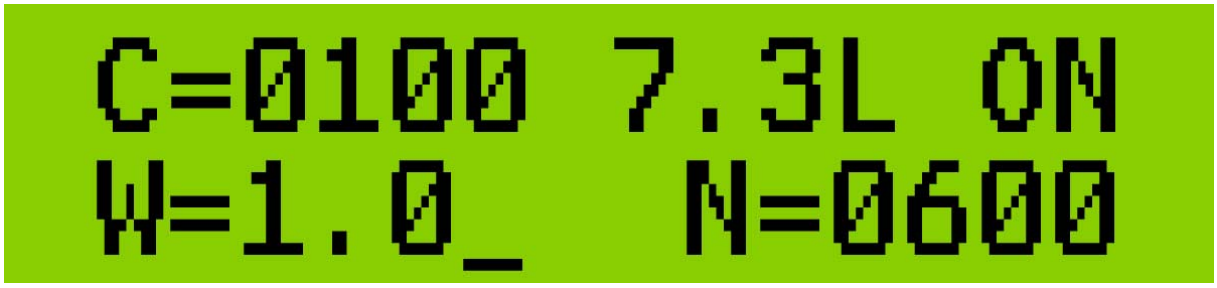
2.3.1 LCD screen

The LCD screen shows the fuel injector setting parameters and injection status

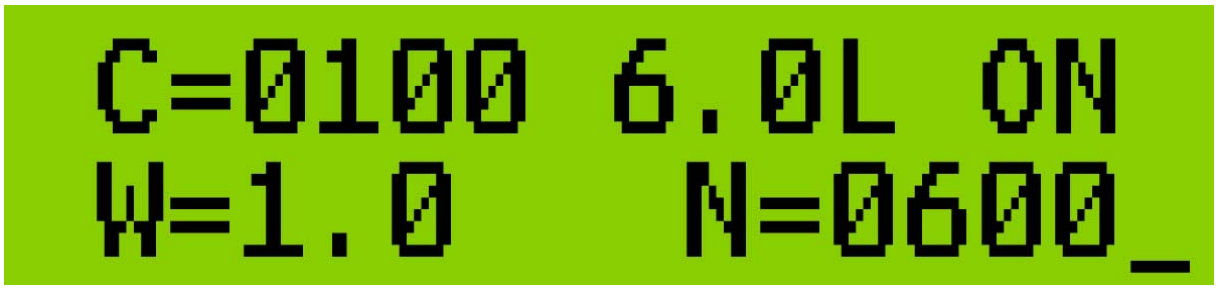
- Initial LCD screen after power ON



- 7.3L Injector is running



■ 6.0L Injector is running



"**C=**" — Fuel injection cycle count-down counter for fuel delivery measurement. Range 1-9999

"**W=**" — Pulse width of fuel injection. In terms of milli-seconds (ms). Range 0-6.0

"**N=**" — Fuel injection frequency. In terms of injection/minute. Range 0-2000

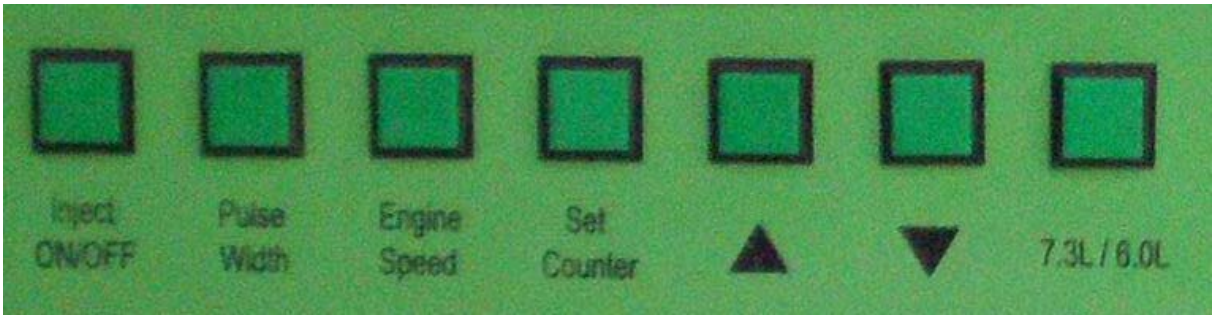
"**7.3L**" or "**6.0L**" — 7.3L Injector or 6.0L Injector.

"**ON**" or "**OFF**" — Fuel injection "**ON**" or "**OFF**".

"_" — Cursor to indicate the parameter currently being edited.

2.3.2 Mini keypad

The mini keypad of the HEUI control module on the front panel, shown below, has five function keys, <**Inject ON/OFF**>, < **Pulse Width** >, < **Engine Speed** >, < **Set Counter** > and < **7.3L/6.0L** >, and two value changing keys 〈▲> and 〈▼>.



Once a function key is pressed, the editing cursor will move to the corresponding parameter on the LCD screen for editing its value.

- Press < **Inject ON/OFF** > to start or stop fuel injection.
- Press < **Pulse Width** > to move the cursor "_" to "**W=**" and ready to edit the value.

- Press < **Engine Speed** > to move the cursor "_" to "**N=**" and ready to edit the value.
- Press < **Set Counter** > to move the cursor "_" to "**C=**" and ready to edit the value
- Press < **7.3L/6.0L**> to choose 7.3L injector or 6.0L injector
- < ▲ > or < ▼ > increase or decrease the value for the parameter with cursor

2.4 Fuel Delivery Measurement

Fuel injection quantity is measured by using 2 groups of 4 glass graduates, 45ml and 150ml, and a solenoid driven plate to direct fuel flow to the fuel tank or to the glass graduates. The On/OFF of the solenoid is controlled by the HEUI control module. The user sets the injection cycle counter using the button **<Set Counter>**. The user pushes the button **<Counter>**to start the measurement. The board to carry the graduates can be turned over to empty the fuel in the graduates.

2.5 Electrical System

The electrical system of the HUS-1000 test bench consists of a divider, an inductive motors, and electrical wiring chamber. By varying the frequency of the AC power, the divider controls the speed of the main motor to drive the pump, which boosts actuation oil pressure. A smaller electrical motor is used to drive the low pressure pump to feed the HEUI's fuel inlets. Figure 2 shows the schematic drawing of the electrical system circuit.

2.6 Device to Detect Injector Leakage

The leakage detection device is a separate box as part of the HUS-1000 package. This device has a potentiometer and an analog amperage gauge meter for adjusting and monitoring the electrical current amperage to drive a solenoid of a HEUI injector. When the leakage test is needed, simply connect the 36VDC on the side board of the HUS-1000 test bench to this unit, and connect the output cable of this unit to the target HEUI, and then turn on the test bench to the required actuation pressure, by adjusting the driving current, the user may observe the sealing condition of the HEUI being tested. The photo below is the device to detect injector leakage.

The side panel of the device is shown below

- Power switch
- Socket for 36VDC power supply and injector drive
- Cooling fan

3 INSTALLATION

a. Unpack the HUS-1000 package

b. Carefully place the HUS-1000 test bench on a solid and leveled floor.

c. The water needs to be connected using locally available hardware.

d. The 3-phase 4-conductor AC power needs to be connected by a qualified electrician. The procedure to connect the 3-phase AC power

Warning: The 3-phase AC power needs to be connected by a qualified electrician to prevent any accident.

- Open the back panel to expose the electrical wire chamber.
- Let the AC power wires go through the hole below the wire chamber
- The 3-phase 4-conductor AC power connection terminals are located at the lowest terminal rack, and labeled as 111，112, 113, and 201, 100.Terminals 111,112, and 113 are for power connection ,and 100 is for ground connection. The neutral wire should be connected to terminal 201. Test the rotation direction of the fuel supply pump, after the AC wire connection. Switch any two input AC power wires if the rotation direction of the supply pump is incorrect.
- Copper wires with 4mm^2 cross-section area should be applied for the 3-phase AC power connection.

e. Place approximately 11 US gallons of suitable calibration fluid in the main tank by pouring it in over the test head

The recommended calibration fluid is Viscor. If you are using a different calibration fluid, it should meet ISO4113 standard. **DO NOT USE DIESEL FUEL**. Diesel fuel will not provide consistent or accurate measurements. Use of diesel fuel may void warranty!

Warning: **DO NOT USE DIESEL FUEL.** Diesel fuel will not provide consistent or accurate measurements. Use of diesel fuel may void warranty!

Caution: **Electrical heater is installed in the test oil tank; the oil level should be higher than the red line on the level observation tube.**

4 TEST BENCH OPERATION

4.1 Injector Installation

Clean the injectors thoroughly to prevent contaminate the expensive test oil.

Install three testing O-rings, Chinahanji P/N **920229**, to replace the original O-rings on the HEUI body. Apply small amount of grease on the O-ring to help placing the O-ring into the grooves.

Place four clean injectors with the test O-rings into the cavities of the injector test head in the testing chamber. Make sure that the injectors are held in place by bolts. The injector and some fluid will be forcefully ejected from the cavity if the injector is not secured, causing injury to the operator and / or damage to the equipment. Connect the wires to the injectors and close the chamber cover lid.

NOTE: When less than four injectors are tested, the dummy injectors should be installed to the unused injector cavities.

4.2 Power on the Test Bench

The AC power of the HUS-1000 is ON by turning the main power switch on the left panel to position "**ON**". The power indicator on the front panel will be lightened once the power is ON.

4.3 Start the Test Oil Heater

Switch **<Heater**> on the front panel to ON position. The electrical heater in the test oil tank will ON automatically once the test oil temperature below the preset temperature on the temperature control module. The heater will be OFF once the test oil temperature exceeds the preset target temperature.

Switch **<Heater**> to OFF position. The electrical oil heater will not ON even the test oil temperature is below the preset target temperature.

4.4 Set Test Oil Target Temperature

The required temperature of the test oil is controlled by the temperature control module. The detailed operation to set the target temperature refers to the user's manual of the control module.

The top half of the module LCD screen displays the actual temperature of the test oil. The lower half displays the lower limit of the target temperature. When the test oil temperature is lower than the target temperature and the heater switch is at "**ON**" position, the heater in the test oil tank is working and the low pressure fuel pump is running to ensure the circulation of the test oil in the tank. When the temperature of the test oil is higher than the target, the heater stops working (regardless the heater switch at "**ON**" position) and the solenoid valve is ON to let cooling water flow through the heat exchanger to cool the test oil to maintain test oil close to the target temperature.

4.5 Start Low Pressure Supply Pump

To turn the <**Supply Pump**> switch to "**ON**" position starts the low pressure fuel pump. The analog pressure gauge on the front panel shows the actual supply pressure. The required supply pressure can be reached by adjusting the pressure relieve valve.

4.6 Start Actuation Pump

Before switch ON the actuation pump, the supply pump has to be running and the <**Actuator Regulation>** knob is in the "Min" position. To turn the <**Actuator Pump**> switch to "**ON**" position starts the actuation pump. Adjust the < **Actuator Regulation** > knob clockwise gradually to increase the main motor speed, and in turn to increase the actuation pressure, which can be monitored by the corresponding analog pressure gauge on the front panel.

4.7 Set Actuation Pressure Maximum Limit

After the actuation test oil passage being purged, the user may turn ON the actuation pump, adjusting the **< Actuator Regulation >** hand wheel to reach the maximum

actuation pressure of current setting. Adjust the pressure relieve valve inside of the bench if necessary to obtain the adequate test oil actuation pressure up-limit.

Warning: Before switching ON the test oil actuation pump, secure all HEUI injectors or dummy injectors in the test head to prevent pressurized test oil and injectors shot up to cause personal injury.

5 INJECTOR TESTS

5.1 Injector Delivery Test

Place clean injectors with testing O-rings into the injector test head. Make sure that the injectors are held in place by bolts. Connect the wires to the injectors, check the fluid level and close the lid.

Using the three function keys of the mini-keypad, < **Pulse Width** >, < **Engine Speed** > and <**Set Counter**> to move the editing cursor on the LCD screen. Using the <▲> and <▼> keys to adjust the values for the parameters, "**W=**", "**N=**" and "**C=**" with the cursor.

After setting the three parameters, press < **Inject ON/OFF** > key to start fuel injection. The user is still able to change the values of three parameters while fuel injection is ON.

The user may press < **Inject ON/OFF** > again to stop fuel injection and the LCD screen will displays "**OFF**".

The test oil actuation pressure may have a sudden change after changing of injection parameters or injection being turned ON or OFF. The user needs to re-adjust the actuation pressure after each parameter setting. When the actuation pressure exceeds the preset maximum limit, the pressure relieve valve will open to spill out excessive test oil.

Once the parameters and the test oil actuation pressure meet the test requirement, pressure <**Counter**> key on the front panel to start fuel delivery measurement. The solenoid driven fuel direction plate is turned to the position to let the fuel injection flow into the metering graduates. Once the count-down counter is reaching zero, the solenoid driven plate is turned to the position to let fuel injection flow to the test oil tank. The fuel delivery test is completed.

The user may press <**Counter**> to abort an on-going fuel delivery test.

Note that the parameters should not be changed during the fuel delivery test.

The fuel in the graduates can be emptied by turning over the carrying board with the knob on the side board.

To avoid personal injury, do not remove any injector from the test head until the actuation test oil becomes atmosphere pressure.

Caution: The injector and some fluid will be forcefully ejected from the test head if the injector is not secured, causing injury to the operator and / or damage to the equipment.

Note: When injector number less four, other positions in the test head must have a dummy injector in them.

5.2 Injector Sealing Test

This test will check the sealing condition of the upper seat of the injector and the injector solenoid control valve by using a separate device. The maximum ON time for this test is 2 minutes otherwise the solenoid may burn out. The followings are the procedure.

- Place the device on the top of the test bench, ensure the current adjusting knob at the minimum current position (counter-clock turn to the end).
- Connect 36 VDC wire on the bench side panel to the device and the injector driving wire to the target injector.
- Turn equipment power ON.
- Turn supply pump ON.
- Turn actuation pump ON.
- Adjust supply pressure to 40~50psi
- Adjust actuation pressure to 1000psi
- Turn the current adjusting knob clockwise slowly. The amp meter will start to rise.

Fluid should be escaping from the injector's return port. Continue to turn the knob. When approximately 3-4 amps is indicated on the amp meter the upper seat should snap shut and fluid should stop flowing.

5.3 Test a 6.0L PowerStroke Engine Injector

5.3.1 Preparation 6.0L injector add-on fixture

The following procedure should be applied to prepare the test bench for testing a HEUI injector for Ford Power Stroke 6.0L engine.

- Place the two O-rings of the sealing kits (P/N **920240**) to the adapt sleeve for 6.0L injector (P/N **920115**)
- Insert the adapt sleeve into one of the injector mounting holes. Insert the fitting (P/N **920213** or **920313**) into the top cavity of the 6.0L injector. Place the restrainer plate for adapter sleeve (P/N **920214**) on the fitting, and fasten the parts to the head block by the two M6-80 bolts (P/N **920217**).
- Remove the actuation oil hose from the test heat block, and connect it to 6.0L injector fitting (P/N **920213** or **920313**). The sealing washer (P/N **920244**) is needed for the connection.
- Connect the 4-pin connector of the bench harnesses to the 6.0L injector.
- The dummy injectors with O-rings sets (P/N **920229**) or 7.3L injectors should be installed into the other three unused injector mounting holes.

5.3.2 Run 6.0L injector test

- Turn on the power switch of the test bench, set the parameters for injector control, the same as those for test 7.3L injectors.
- Press < **7.3L/6.0 L**>, the LED screen becomes "**6.0L OFF**" from "**7.3L OFF**", press < **Inject ON/OFF** > then LED screen changes to "**6.0L ON**" and the solenoid of 6.0L injector starts to klick.
- Turn on the fuel supply pump, adjust the supply pressure to the required reading.
- Turn on the actuation pump, adjust the pressure and the 6.0L injector starts fuel injection.

5.3.3 Remove 6.0L injector fixture

- Loose the actuation oil hose from the 6.0L injector fitting, and connect it to the inlet port of actuation oil on the test head block. An O-ring (P/N **920243**）is required for the hose connection.
- Using the removing tool (P/N **920261**) to pull out the injector from the adapt sleeve.
- Using the removing tool (P/N **920260**) to pull out the adapt sleeve.

6 MAINTENANCE AND SERVICE

Two filters are applied in the test oil circuit, one at down stream of the supply pump and the other at the inlet of the actuation pump. The filters should be changed in a period of six months.

The filter in test oil tank is **Chinahanji P/N 920098**

The filter for fuel supply circuit is **Fleetguard FF5485**

The filter for actuation circuit is **Chinahanji P/N 920101**

Periodically check the level of the test oil in the tank. The oil level should not below the red line on the observation side tube.

7 WARRANTY

Chinahanji will replace free of charge HEUI system test bench HUS-1000, which fails in use within a time period of one year from the date of delivery due to faulty material or workmanship, as determined by Chinahanji, provided that the HUS-1000 is returned prepaid to Chinahanji within one month from the date of failure with an APPLICATION FOR REPLACEMENT UNDER WARRANTY signed by a responsible engineering representative of the customer.

This warranty does not cover any coincidental or consequential damages of the HUS-1000.

During the warranty period, Chinahanji is not liable for any losses or damages of any kind resulting from the improper use of this product, and user charges for the repair cost.

After the warranty period, user charges for the repair cost.

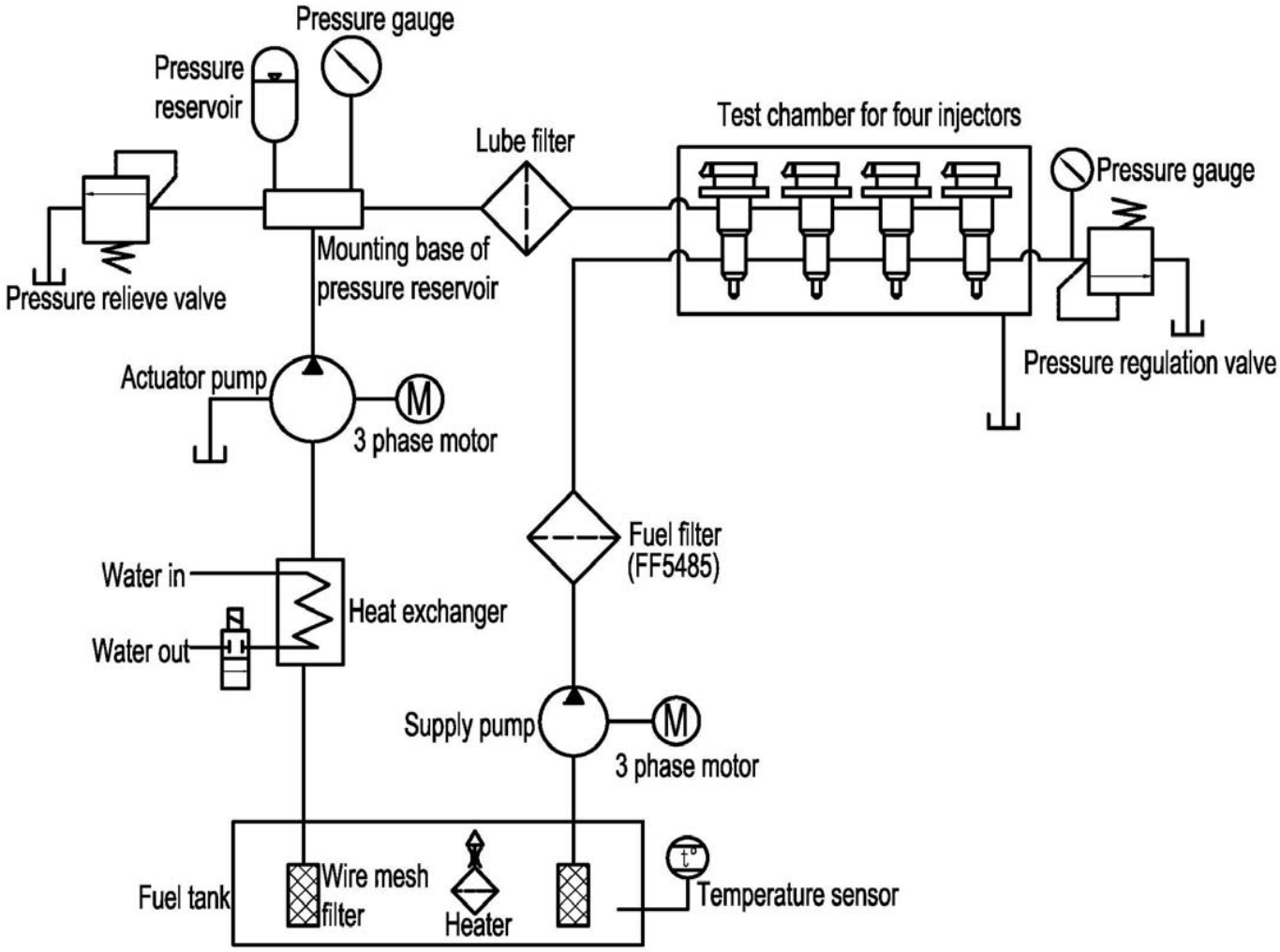
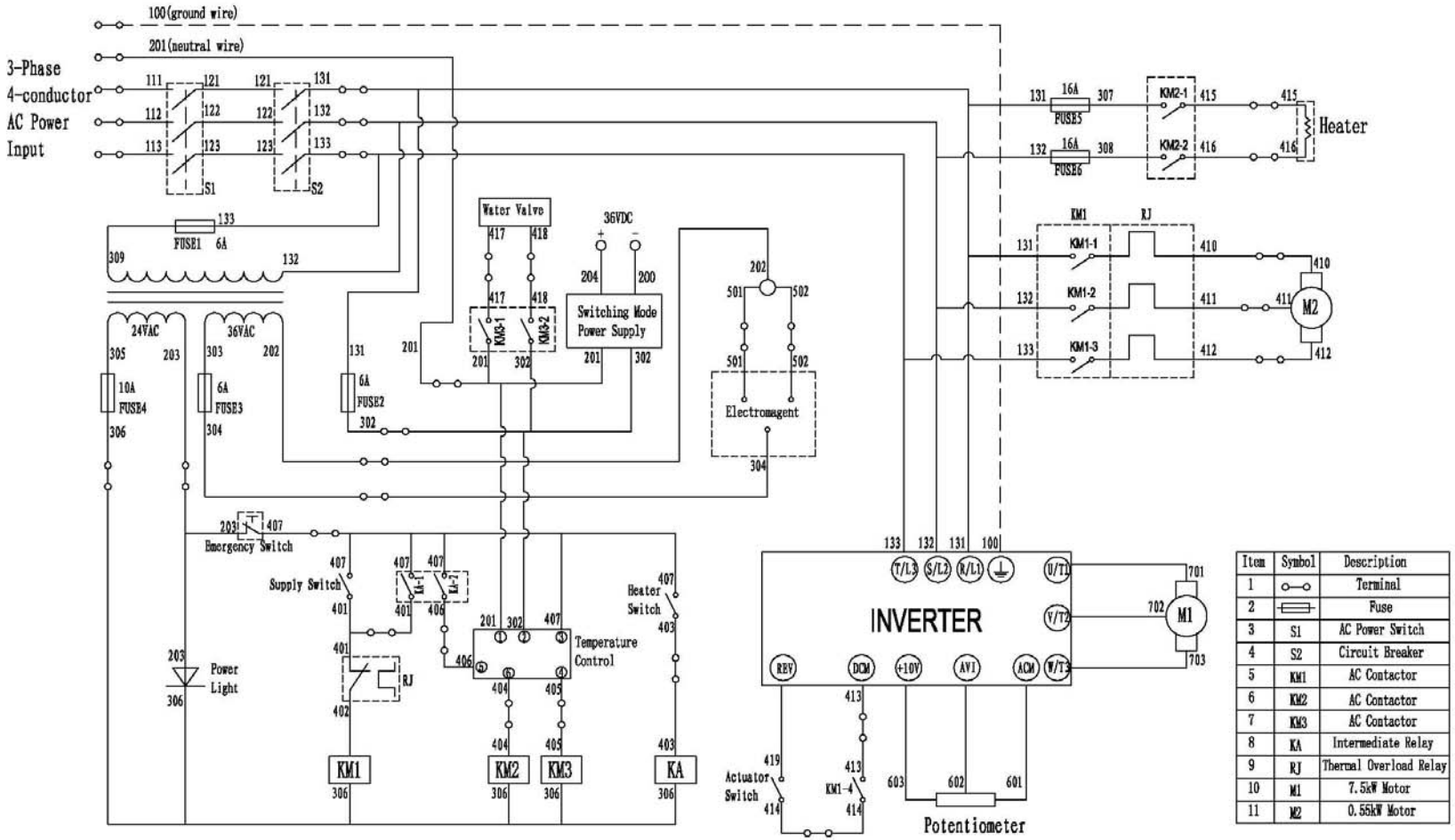


Figure 1 The hydraulic circuit of the HUS-1000 Test bench



Item	Symbol	Description
1		Terminal
2		Fuse
3	S1	AC Power Switch
4	S2	Circuit Breaker
5	KM1	AC Contactor
6	KM2	AC Contactor
7	KM3	AC Contactor
8	KA	Intermediate Relay
9	RJ	Thermal Overload Relay
10	M1	7.5kW Motor
11	M2	0.55kW Motor

Figure 2 The circuit schematic drawing of the electrical system